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Dislocation Motion and Plasticity in Small Scale Structures: the influence of surfaces/interfaces and boundary constraints

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ABSTRACT

Interfaces such as surfaces or grain boundaries play an important role for many physical properties of such devices. In thin films, grain boundaries migration driven by the interface reduction lead to grain sizes, which are limited by surface drag as soon as the grain has reached both surfaces.

The mechanical properties of these thin films are investigated by three dimensional dislocation dynamics [1]. To simplify the model, it is assumed as a first step that the grain boundaries are impenetrable to dislocations. This assumption leads to the formation of pile-ups largely controlling the mechanical response. The statistical analysis of the stress-strain curve of single, bi- and polycrystalline show however, that the observed statistics does not depend on the details of the dislocation motion [2].
As a second step a new approach is proposed, which allows to accomodate dislocations within a grain boundary and effectively leading to a dislocation absorption and transmission at GBs in the framework of a three dimensional dislocation dynamics tool. This model is compared for simple geometries, tilt GBs, to MD results.

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